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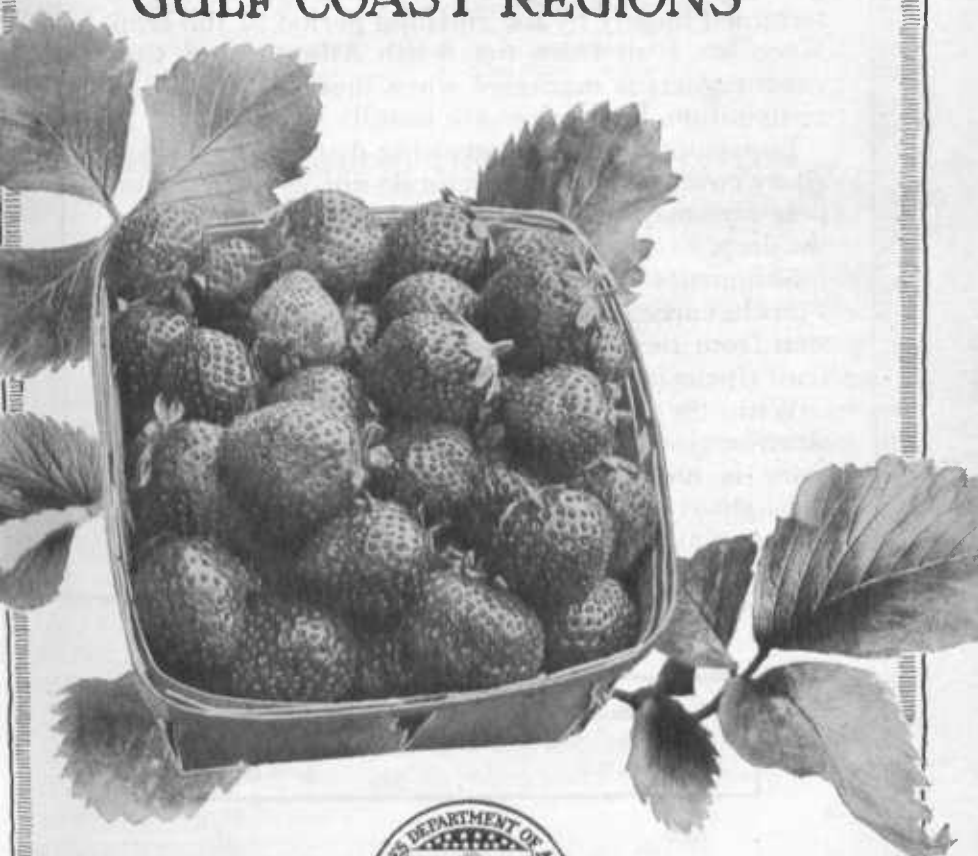
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FARMERS' BULLETIN 1026
United States Department of Agriculture

STRAWBERRY CULTURE

SOUTH ATLANTIC AND
GULF COAST REGIONS

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STRAWBERRY growing is an important industry in certain districts of the South Atlantic and Gulf States.

Because of the mild climate, especially in the warmer parts, the plants grow during nearly the entire year.

Methods of culture and handling are quite different in many respects from those in other parts of the country; those which have proved successful are described and their significance indicated in this bulletin.

The commercial importance of one strawberry-growing district, compared with other districts, is determined largely by the ripening period of the crop. Since the fruit from the South Atlantic and Gulf coast regions is marketed when there is little or no competition, high prices are usually received.

Important strawberry-growing districts in the territory covered by this bulletin do not, as a rule, compete seriously with one another in the marketing of the crop.

Shipments of strawberries begin from central Florida early in the winter and continue in succession from the various districts northward until the fruit ripens in the northern districts.

With the help of the everbearing varieties of strawberries, it is possible for the consumer to whom price is no object to obtain almost continuously throughout the year fresh strawberries ripened in the open air.

Contribution from the Bureau of Plant Industry

WM. A. TAYLOR, Chief

Washington, D. C.

April, 1919

STRAWBERRY CULTURE: SOUTH ATLANTIC AND GULF COAST REGIONS.

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REGION TO WHICH THIS BULLETIN APPLIES.



THE AREA to which this bulletin applies is shown in figure 1. It includes in general the Coastal Plain region in the States of Texas, Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina, Virginia, and also a part of Arkansas.

Strawberries are shipped to northern markets from different districts in this region throughout the winter and early spring. In 1914 the shipments totaled 2,504 carloads, and 2,684 carloads in 1915, or about one-fifth of the total shipments of the country. The accompanying map (fig. 2)

shows the large centers of strawberry production in the South as well as in other regions of the country, and the approximate season of ripening in each.

Strawberry growing practices in the South are very different from those used in Northern States, and for that reason directions applicable to strawberry growing in other parts of the country are of small value there.¹

¹ See Farmers' Bulletins 1027, "Strawberry Culture: Western United States;" 1028, "Strawberry Culture: Eastern United States;" and 1043, "Strawberry Varieties in the United States."

WHERE TO GROW STRAWBERRIES.

In selecting a location in which to raise strawberries, the factors which should be considered are transportation facilities for shipping the fruit, convenience in securing pickers, crates, boxes, and other supplies, and the period of ripening of the fruit with reference to other strawberry-growing regions. A location where the berries ripen during a period when the markets are not well supplied is better, other things being equal, than one where the fruit ripens so that it is shipped in competition with that from other regions.

If a farm is located on the main line of a railroad leading to northern markets, the transportation service is likely to be good. In

a locality in which many others are already growing and shipping berries, it should be easier to secure satisfactory transportation service, supplies, and experienced labor than in one where strawberry growing is not a community interest.



FIG. 1.—The area to which this bulletin applies in the South Atlantic and Gulf Coast States is indicated by the shaded portions. The heavily shaded portion shows the regions where the hill system of strawberry culture is commonly practiced.

The map (figure 2) shows that during the winter and spring the ripening season constantly

progresses northward, and shipping from the different districts is discontinued as soon as berries from those next farther north are ripening freely. Of course, if the crop is poor in some northern district, growers south of it can continue to ship profitably longer than would otherwise be possible. By noting the districts in which the berries ripen at the same time and studying the railroad lines over which those from the different districts are shipped, the logical markets for shipments from any district can be determined readily.

The succession of the shipping seasons along the Atlantic coast is about as follows: The Plant City district of Florida is normally the only source of supply of strawberries for northern markets throughout December and January, and shipments are usually at their height in February, when the Starke-Lawtey district of northern Florida begins to ship small quantities. In March, the shipments from the latter region become heavy, and at the same time they

stop from the Plant City district, unless late frosts or other weather conditions hold back the ripening in northern localities. In the latter part of April, shipments from North Carolina begin to be



Fig. 2.—Outline map showing the strawberry-shipping regions of the United States. Each dot represents 10 carloads, except where they occur singly and may represent any number of carloads up to 10.

heavy, and growers in the northern Florida district discontinue shipping. Then berries from the Norfolk district replace those from North Carolina, and shipments from Norfolk are followed in turn

by those from districts still farther north. Similar crop successions occur in Alabama, Louisiana, Mississippi, and also in Texas and Arkansas.

CHOOSING THE SITE FOR A PLANTATION.

Soil drainage.—As the strawberry is easily injured by poor soil drainage, soils must be selected on which water never stands. In the sections included in the area to which this bulletin applies, this is especially important, for the land is usually low and often poorly drained. In winter the evaporation is less than at other seasons, and when heavy rains occur, the plants may be drowned out entirely or so weakened that their growth is stunted. Leaf, root, and fruit diseases will also be more abundant on such sites than where the drainage is good.

Soil type.—There is no particular type of soil to which the varieties of strawberries grown in the area are best adapted. In Texas, coarse sandy, fine sandy, and heavy gumbo soils are used extensively; in Louisiana, a heavy silt loam and sandy loam; in Florida, both heavy silt and coarse sandy loams and muck soils; and elsewhere still other soil types are used. In each section, however, the soil type most easily managed and the one with the greatest humus content is generally preferred. Thus, in the vicinity of Houston, Tex., a gumbo soil mixed with a large quantity of sand is favored; in the section about Hammond, La., a silt loam mixed with sand; and in the Plant City district in Florida, a black sandy soil is the preferred type.

PREPARATION OF THE SOIL.

The preparation of land for the planting of strawberries should be complete and thorough. The soil should be abundantly supplied with humus when the plants are set, either by making adequately heavy applications of manure or, previous to planting, by the growing and turning under of one or more green-manure crops, preferably a legume, such as clover, cowpeas, or some other crop adapted to the region.

Thus, the preparation of the soil may need to begin the season or perhaps two seasons before the plants are set. The latter is true of sod land, particularly in regions where white grubs are serious. These grubs are the larvæ of May beetles, or June bugs, and frequently are abundant in sod land, where the eggs are commonly laid. If strawberries are planted on land infested with large numbers of white grubs a heavy loss of plants on account of the roots being eaten by the grubs may be expected. Since the white grubs remain in the soil in the worm or larval stage for about two years and, further, as the grass roots in the sod might interfere with the suit-

able preparation of the soil, sod land usually should be devoted to hoed crops for two seasons after it is first plowed before it is planted to strawberries. During this period, by proper management, the humus content can be renewed if desirable.

NEMATODE INJURY TO STRAWBERRIES.

Because of the seriousness of nematodes on strawberries in the South, the nature, extent, and control of these parasites, which require attention in connection with the preparation of the soil, should be clearly understood by all growers. Because of its effect on the roots of the plants the trouble is commonly called root-knot.

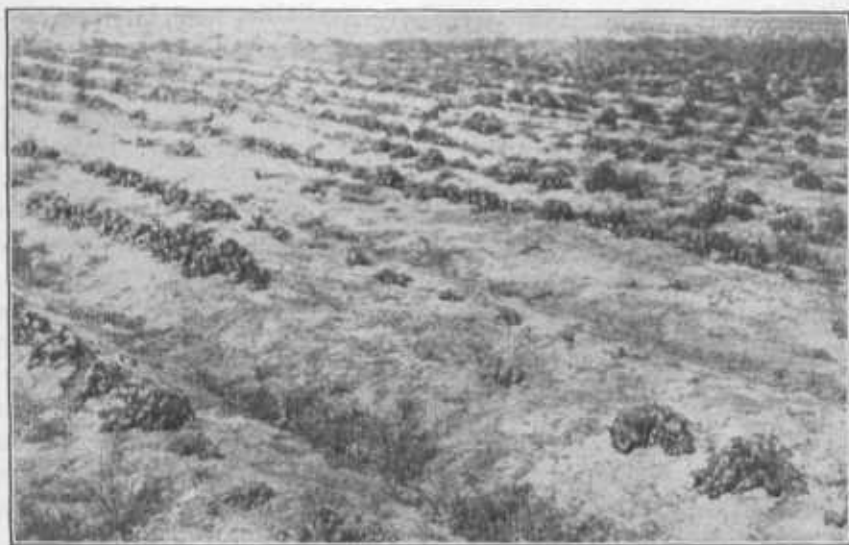


FIG. 3.—A strawberry bed that has been injured by nematodes. Most of the plants in the foreground have died, and those that remain are very feeble. The nematodes have probably decreased the yield from the plants which appear fairly vigorous. (Photographed at Plant City, Fla., March 2, 1916.)

Nature of the trouble.—This nematode—also called the gallworm and the eelworm—is a very minute, wormlike organism one-sixtieth to one-twentieth of an inch in length. It penetrates the small roots of plants and causes numerous swellings or knotlike enlargements which interfere with the passage of water through the roots. The roots may be affected seriously, however, even when no prominent enlargements can be seen on them.

Extent of injury.—Nematodes are most abundant in the South, where the soil rarely or never freezes to any considerable depth. They are more injurious in sandy than in heavy soils, although they sometimes cause serious injury to strawberries on heavier soils.

Strawberries are known to have been injured seriously by nematodes in the Tyler section of Texas, in the Hammond section of Louisiana, in various sections of Mississippi and Florida, in the Chadbourne section of North Carolina, in the Norfolk section of Virginia, and in other parts of the United States. Undoubtedly, they will be found in still other parts of the South. The affected fields may be so seriously injured that the crop is not worth harvesting, and even the entire stock of plants may be lost during droughts. Strawberry growing at what was formerly one of the largest shipping points in the South is reported to have been given up because of nematode injury. Figure 3 shows a field in which the plants in one area have been either killed or seriously weakened by nematodes.

Avoiding nematode injury.—Where available, new land or that known to be free from nematodes should be used for strawberries. Not often, however, is such land available in the South. Because of the destructiveness of nematodes to strawberry plants when set in infested soil, the preparation of such land for planting strawberries must include the freeing of it from this parasite. This can be accomplished in the course of two to three years by the starvation process. Either the land must be kept bare of all vegetation by frequent cultivation, or only crops that are practically immune to the nematode should be grown on it during this period. Nematodes are known to be able to exist in soil for more than a year even when no food plants are present, but probably not over two years. However, the practical difficulties of completely controlling vegetation need to be considered. If, therefore, immune or very resistant crops are grown for two or preferably three seasons and no nematodes are brought in on plants, tools, or by other means, a field free from them can be obtained.

Nematode-resistant crops.—Common crops and plants known to be immune or very resistant to this parasite which may be used in rotations intended to free the soil of them are corn, sorghum, winter oats, rye, pearl millet, wheat, Iron and Brabham cowpeas, velvet beans, peanuts, and beggarweed. Many of the most valuable crops, such as cotton, sweet potatoes, cabbages and many other garden vegetables, peach and fig trees, and numerous other crops widely grown in the South are so susceptible that they can not be grown on land while it is being freed from nematodes.¹

In North Carolina many growers use the following rotation: After strawberries, corn is planted with a nematode-resistant variety of cowpea drilled in the rows; then the cowpeas are turned under and

¹ See Farmers' Bulletin 648, entitled "The Control of Root-Knot," for further information regarding nematodes and their control. It may be obtained free, on request to the Department of Agriculture.

winter oats are sown. In the spring the oats are plowed under or harvested, and corn and cowpeas again planted. After this corn crop is harvested and the cowpeas are plowed under, strawberries are planted in the autumn and oats sown among them. The next spring the oats are harvested and the strawberries cultivated and hoed.

Other rotations using resistant crops will be suggested by the particular needs of individual growers.

Whatever the crop or previous treatment of the soil prior to planting it to strawberries, the management



FIG. 4.—A. This field has been plowed into ridges and is being set to strawberries. The raised beds help the drainage on wet land. (Photographed at Independence, La., November 17, 1914.) B. The strawberry plants have been set on the raised beds. In the background, piles of pine needles are seen which will be used for mulch. (Photographed at Independence, La., January 28, 1915.) C. The tops of the ridges are being leveled with a plank drag attached to a cultivator, before setting the plants. (Photographed at Mount Olive, N. C., May 28, 1915.)

should be such that it will be in a high state of fertility and contain an abundant supply of humus (decaying vegetable matter) when the planting is done. A liberal content of humus is particularly important because of its effects upon the productiveness of the soil and its moisture-holding capacity. Moreover, the soil must

be put in thorough condition for planting by plowing and harrowing or by such other operations as are necessary to pulverize it and make it mellow.

FINAL PREPARATION OF THE SOIL FOR PLANTING.

In most sections of the area to which this bulletin applies, the land is low and the drainage often poor. To meet this condition the plants are commonly set on ridges 3 to 12 inches above the furrows which separate them, as shown in figure 4. Such methods of plowing as will form suitable ridges and furnish good drainage should be employed.

The height and width of the ridges will depend on the character of the soil and on the slope of the field. Unless the conditions are unusual, ridges 6 to 9 inches above the bottom of the furrows are sufficient. The width of the ridges, which varies greatly in different sections, is further considered under "Planting and training systems." Figure 4, *A*, shows the ridges thrown up and being planted. The tops of the ridges are commonly leveled with a plank drag, as shown in figure 4, *C*. Relatively small, narrow ridges are also shown between the wider planting ridges and in the center of what later will be the furrows. The earth from these will be thrown on the sides of the planted ridges to make them wider, as shown in figure 4, *B*.

ESTABLISHING A STRAWBERRY PLANTATION.

HOW TO OBTAIN PLANTS.

In Florida, because of the nematode and other troubles, the growers as a rule obtain a limited number of plants each year from northern nurseries. These plants are set in the winter months about 3 feet apart in rows about 4 feet distant, and serve practically as "mother plants," from which, as a starting point, the plants that in due course make the fruiting plantation are secured.

Thus, fresh stock is brought annually from regions not infested with nematodes and other troubles more or less prevalent in the South, which would soon become serious in the fruiting plantations if the new stock of plants was obtained year after year from local sources.

Parent plants from the North.—The manner of handling the mother plants and of obtaining the stock for fruit production, together with the time of performing the various operations in Florida, is about as follows:

January to March.—New "mother plants" from northern sources are obtained and set. These should start into growth at once.

June.—By this time the mother plants set from January to March should have developed enough runner plants to set a considerably increased area.

August.—The runner plants from the June setting should be ready for planting a more extended area.

October and November.—In turn, the August-set plants should have developed runners. These plants are now set with a view to forming the main fruiting plantation.

The exact time of making the original planting and of the several transplantings of the runner plants naturally varies with weather conditions. The months given, however, are those in which the transplanting usually is done if moisture conditions are favorable or are



FIG. 5.—These strawberry plants were brought from the North and set in February. By the first of June they will have made a dense mat of plants which will be used to set out a larger propagating bed. The plants grown on this will be set on a still larger area in August, and these will produce the plants which will be set in the fruiting beds in October and November. (Photographed at Plant City, Fla., March 27, 1915.)

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under control (as when an overhead sprinkling system of irrigation is used). A field set in February which is to be used as a propagating bed is shown in figure 5.

Some growers prefer to leave the bed made by runners from the original plants until September and at that time attempt to encourage the development of vigorous runner plants for use in setting the plantation to bear fruit. This latter practice, however, has not been found as satisfactory as the former one, and a much larger number of plants must be brought from the North for the original planting from January to March than is necessary when the transplanting is done in June.

By the foregoing practice it is possible to have a sufficient number of plants to set a large fruiting area from a small original stock of plants. Moreover, plants raised in Florida in this manner will have

larger crowns and will bear much better than those brought from the North in October or November and set at once for fruiting the following winter. In general, growers have found the latter unprofitable.

Raising fruiting plants.—In the Louisiana strawberry district the plants used at present are propagated from local stock. A part of the old field which has fruited is kept free from weeds, and the runner plants from this bed are used for setting in the autumn. Figure 6 shows a field at Hammond, La., which is to be used as a propagating bed. The mulch has been raked up and the weeds and poorer plants dug out. By November a wide bed of plants should have formed. Some of the most progressive growers, however, transplant the runner plants in July, and from this new bed raise plants which are set later to make the fruiting plantation.



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FIG. 6.—The mulch is being raked from the strawberries and stacked for use another season. The old plants have been cut out, and from the remaining ones the plants to be set in the autumn will be propagated. (Photographed at Hammond, La., June 15, 1914.)

As the nematode is common in Louisiana, plants when secured locally should be from fields free from these pests; otherwise they should be obtained from northern sources. Runner plants from the North should be set in July in order to produce runner plants for setting the fruiting plantation.

In some parts of Texas, and to some extent also in North Carolina, plants are secured each year from northern nurseries. Growers who follow this course believe that they obtain better results than by using their home-propagated plants. In other localities plants are either propagated year after year from those locally grown or a stock is brought every few years from the North. Unless their plants are free from nematodes, growers in these sections should be able to increase their yields by securing their stock from the North each year. The northern stock should be healthy and should be grown in soil free from nematodes. Florida growers have found it necessary to obtain plants from as far north as Maryland, and prob-

ably would prefer to secure them from still farther north if it were possible to dig and ship them in the winter.

The practices with reference to securing plants suggested for the various districts, other than those in Florida, which are given above, are as follows:

Norfolk (Va.) and Mount Olive (N. C.) districts.—Secure plants in February and March from the North or from local fields known to be free from nematodes. Use them to set permanent fields.

Chadbourn (N. C.) district.—Follow the above practice or set plants in February or March and raise plants to set in the fruiting plantation in August or September.

Alabama and Mississippi districts (except Bay St. Louis, Miss.).—Follow the practice suggested for the Norfolk (Va.) district.

Hammond (La.) and Bay St. Louis (Miss.) districts.—Follow either the first or second method specified below:

- (1) January to March: Set mother plants from the North. June 15 to July 15: Use the best of the runner plants from those set from January to March to set a larger area of stock plants. October to December: Use the best of the runner plants from those set in June or July to set the fruiting plantation.
- (2) May: Cultivate and weed out the bearing field or a portion of it immediately after the picking season. June 15 to July 15: Use the best of the runner plants from above to set a new plantation for making plants. October to December: Use the best of the runner plants from the field set in June or July to set the fruiting plantation.

Houston (Tex.) district.—December to March: Secure plants from the North in sufficient quantity and set the permanent fruiting plantation.

Tyler (Tex.) district.—February to April: Follow the practice advised for the Norfolk (Va.) district.

Not only must all possible precautions be taken to avoid obtaining plants infested with nematodes, but also to avoid certain prevalent diseases.

“**Crimps**” or “**white buds.**”—In Florida, as well as in some other sections, one of the most serious diseases to guard against is called “crimps,” “erimp plants,” or “white buds.” The cause of the disease is unknown, but plants affected by it do not bear fruit. Usually no blossoms or berries are produced, though in some cases a few imperfect berries are formed. Affected plants are recognized by a peculiar twisting of the central and younger leaves, often accompanied by a slight yellowing of the diseased leaves. No central bud develops in these plants, as it does in healthy plants. Experienced growers are able to recognize the “crimps” in their propagating beds and discard them. As the only known means of control is prevention by using healthy plants, all suspicious plants should be discarded when setting is being done. This disease is common in Florida, Louisiana, southern Mississippi, and North Carolina, and has been found in the Norfolk (Va.) district.

TIME OF PLANTING.

In general, the planting seasons have already been indicated. Where the hill system (to be described later) is used, however, certain facts should be remembered. In Florida most of the plants from which the crop is produced are set in October. As those set in the latter part of October begin to bear earlier than those planted in September or those set in August, growers use this characteristic to regulate to some extent the bearing season.

In the Hammond (La.) district the plants set in November are usually better than those set at other times, while those set as late



FIG. 7.—Strawberry plants set in single rows on slightly raised beds. The plants in the row at the right were set in October, while those in the rows at the left were set on December 22, 1914. The later-set plants were better, produced more fruit, and required less tillage. (Photographed at Hammond, La., April 14, 1915.)

as December 20 may be satisfactory. Figure 7 shows part of a field at Hammond in which the rows to the left were set on December 22, 1914, and those to the right in October of the same year. Because of weather conditions which affected their growth, the plants set in October did not grow or produce as well as those set in December, and they required more tillage.

PLANTING AND TRAINING SYSTEMS.

Generally, two planting systems are used in the South, the hill system and the matted-row system. The map shown as figure 1 indicates the sections in which each system is principally used.

Hill system.—Under the hill system the plants are commonly set in late summer or autumn and the crop harvested during the winter or the following spring. Usually plants set at that time make no runners, but if any do appear they are removed. When this system is used, the plants may be set in single, double, or triple rows, as shown in figure 8, *A*, *B*, and *C*.

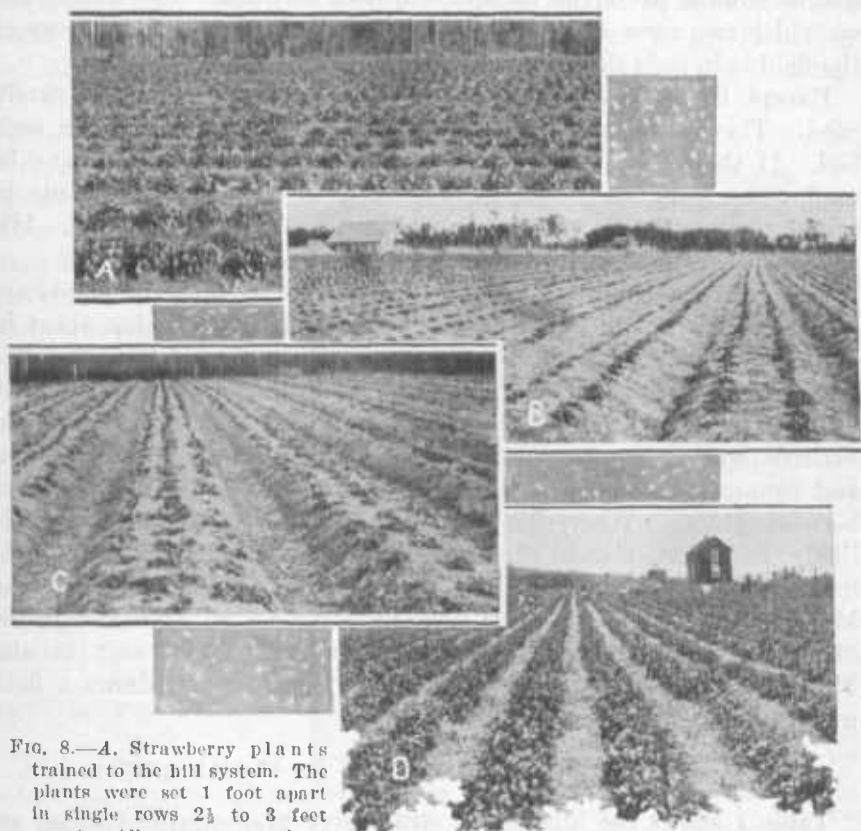


FIG. 8.—*A*. Strawberry plants trained to the hill system. The plants were set 1 foot apart in single rows $2\frac{1}{2}$ to 3 feet apart. All runners are kept off. (Photographed at Plant City, Fla., February 3, 1915.) *B*. Strawberry plants set in two rows to each raised bed. The plants are 14 inches apart in the rows, which are 22 inches apart. The alleys between the beds are 32 inches wide. (Photographed at Starke, Fla., February 6, 1915.) *C*. Strawberry plants set in three rows to each raised bed. This plan rarely is followed except in the Starke, Fla., region, though occasionally elsewhere. (Photographed at Hammond, La., November 22, 1914.) *D*. Strawberries in matted rows, well grown, and mulched with straw. Under this system, plants are set commonly in winter or early spring 18 to 40 inches apart in rows $3\frac{1}{2}$ to 4 feet distant. The runners are allowed to root.

Whenever the hill system is employed in the Chadbourne district of North Carolina, in the central Florida sections, and in the Hammond (La.) district, the single row is generally used. The plants are usually set about 1 foot apart in rows 3 feet distant, as shown in figure 8, *A*. Occasionally the rows are set $3\frac{1}{2}$ feet apart.

In the northern Florida section, and to some extent in others, the double-row system is preferred. In northern Florida the rows are set 20 to 24 inches apart, and an alley 2 to 3 feet wide is left between pairs of double rows, as shown in figure 8, *B*. Where double rows are set in central Florida and in Louisiana, these rows are 12 to 15 inches apart and the alleys 3 to 4 feet wide. The practice of setting double rows is preferred by many in both sections. The wider beds on which two rows are set allow more plants to the acre and more of the field is in beds than when single rows are used.

Except in the Starke section of Florida, triple rows are rarely used. There three rows are often set 20 to 24 inches apart on each bed. If there is no likelihood of poor drainage, this plan may be used. One very successful grower in Louisiana sets his plants in triple rows with the plants 12 to 14 inches apart each way. His plan is illustrated in figure 8, *C*.

Matted-row system.—Under the matted-row system, the plants are commonly set in the winter or early spring 18 to 40 inches apart in rows $3\frac{1}{2}$ to 6 feet distant, and the runners are allowed to root. The distance at which the plants should be set in the row depends chiefly upon the danger of loss of plants by drought and insects. If there is little danger of loss, the plants may be set 40 inches or more apart, and runner plants may be trained to form a solid mat in the spaces between plants. Where loss from either of the causes mentioned is likely, the plants should be set about 18 inches apart. The matted-row system is commonly used in the Norfolk (Va.) district, the Mount Olive and Chadbourn (N. C.) districts, in Alabama, in all of the Mississippi districts except Bay St. Louis and in the Houston and Tyler districts of Texas. Figure 8, *D*, shows a field grown under the matted-row system.

NUMBER OF PLANTS REQUIRED TO SET AN ACRE.

Table I shows the number of strawberry plants needed to set an acre of ground when spaced in accordance with the systems commonly used.

TABLE I.—*Number of strawberry plants required to set an acre of ground when spaced at different distances apart.*

Distance apart.	Plants to the acre.	Distance apart.	Plants to the acre.
2 feet by 1 foot.....	21,780	2½ feet by 1½ feet.....	11,616
2 feet by 1½ feet.....	14,520	3 feet by 2 feet.....	7,260
3 feet by 1 foot.....	14,520	3 feet by 3 feet.....	4,840
3½ feet by 1 foot.....	12,446	3 feet by 4 feet.....	3,630

Where there is little danger of loss of plants from any cause, only the number specified above will be needed. If there is considerable

danger, a somewhat larger number should be secured in order to insure a full stand, as the expense of irrigating and caring for a field which has many blank spaces will be out of proportion to the value of the crop obtained.

CARE OF PLANTS.

Good plants in bundles of about 25 each as they are received from the nursery are shown in figure 9. They should be kept cool and moist until set. If they are to be set the same day or the following day, they should be placed in the shade and covered with wet burlap. If, however, conditions are such that they can not be set for several days, the bundles should be opened and the plants separated and heeled in, as shown in figure 10.

The plants should not be dropped far ahead of the setters, especially on dry, windy days, and those dropping the plants should use some means of protecting their supply, as shown in figure 11.

SETTING THE PLANTS.

Plants may be set with the hand, with a dibble, spade, or punch, or with a machine made for the purpose. Whatever the method used, two things are of special importance in obtaining successful results: Setting the plants at the right depth and making the soil very firm about the roots.

The plants should be set so that the crowns are even with the surface of the ground after the soil has been packed about the roots. The proper depth for planting is illustrated in figure 12.

If the soil is not properly firmed about the roots, air gets to them and they are likely to dry out. Besides, such plants usually will start



FIG. 9.—Good Klondike and Dunlap strawberry plants, in bundles as they are commonly received from the nursery, showing the difference in root growth of these two varieties. Each bundle is supposed to contain 25 plants.

a feeble growth or none at all. If the soil is thoroughly firmed very little trouble will be experienced in getting plants to live. Some growers step on each plant after it has been set in order to make sure that the soil has been properly firmed. When this is done, the instep should come over the crown of the plant in order to avoid injuring it.

Setting by hand.—Setting by hand is not often practiced except in very loose soils, but in such soils this method is very satisfactory. A

wedge-shaped opening about 4 inches deep is made in the soil with one hand and the roots inserted with the other. The earth is then drawn about them and firmed. Plants may be set quite rapidly in this manner, but the work is hard and the soil seldom sufficiently



FIG. 10.—A. Kneeling in strawberry plants. The bundles are opened and the plants spread out in a trench with the crowns even with the surface, as here shown. B. The trench in which the plants have been placed, as shown in A, has been filled with moist soil covering the roots, and the soil is being packed firmly about them. Here they are left until wanted for setting in the field.

meadow. It is chiefly used in sections where the plants are set close together and those setting them do not have to move about much.

Setting with a dibble or punch.—In most sections an opening is made in the soil with a dibble, trowel, or punch. Dibbles and trowels of different sorts used for this purpose are shown in figure 13. With one of these implements, an opening 4 to 6 inches deep is made in the soil, the roots inserted, and the earth pressed back firmly about them. When a punch is used, one man usually goes ahead making the holes,

another follows dropping the plants, and one or two others place the plants in the holes and draw the earth about them. The punch can not be used readily in soils which have any straw or stones in them, but it is well adapted for use in loose soils. The dibble, however, can be used in any well-prepared soil.

Setting with a spade.—Two men form a setting crew. One inserts the spade and by forcing it forward opens a hole. After the roots of the plant have been inserted, he withdraws the spade and with his foot presses the soil firmly about the roots. The second man carries the plants and inserts them in the holes as they are made by the spade. Plants can be set rapidly in this manner, and the method is widely used.

Setting with a paddle.—A paddle like that shown in figure 14, *A*, is often used. The plants are dropped in the exact place where they are to be set, and a man following presses the roots into the ground with the paddle and thoroughly packs the earth about them with his foot. Plants can be set very rapidly when this method is used, but the soil must be loose and friable. A variation of this tool called a "packer" is shown in figure 14, *B*. The plant is pressed into the ground with a paddle and the earth firmed around it with the packer.

Setting with a punch and tongs.—Another method of planting is with a punch and tongs, as shown in figure 14, *C*. This method is used more extensively in setting sweet potatoes than for strawberries. A hole is made with the punch, the plant picked up with the tongs and placed in the hole, and the earth firmed with the foot. One accustomed to the use of this tool can set 10,000 plants a day with it, while an expert can set many more. Under favorable soil conditions, it is easier to set 10,000 plants a day in this way than to set 5,000 with a dibble or trowel.

Setting by machine.—On level land, planting machines used in trucking sections in transplanting tobacco, tomatoes, cabbages, sweet potatoes, and the like, are often used to set strawberry plants. The soil should be moist or water must be applied when the plants are



FIG. 11.—Dropping strawberry plants from a fertilizer sack. A slit is cut for the head near the top and one across the outer side near the center. The plants are placed in the bottom where they are protected from sun and wind.

set with a machine. Usually one man drives the machine and two others feed plants into it. About 30,000 plants, or 3 to 5 acres, a day can be set in this way.

The chief difficulty in the use of a planting machine is that it is difficult to set all the plants at the right depth. After some practice, however, intelligent droppers become so expert that practically all plants are set at the proper depth with the roots straight down. A roller attached to the planter may be used to firm the soil, or a man may be employed to walk along the rows firming the plants with his foot. When all conditions are favorable, especially in sections where

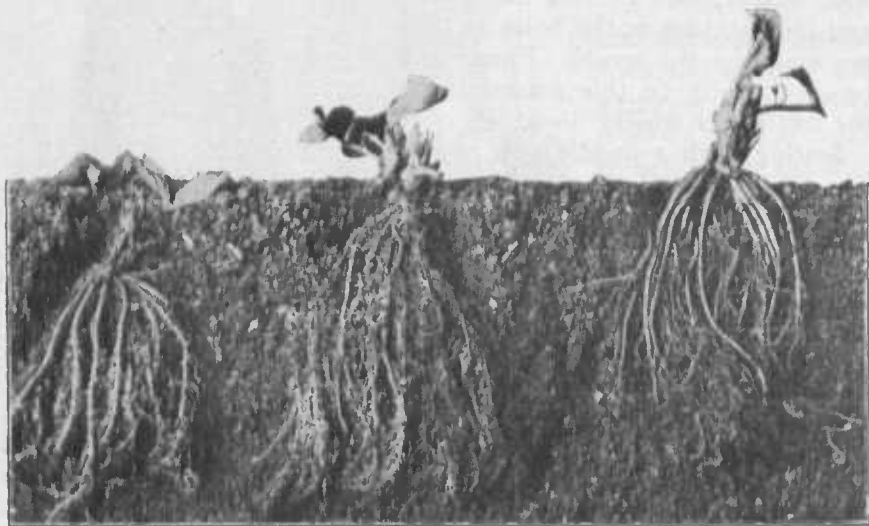


FIG. 12.—Strawberry plants set at different depths. The plant at the left is set too deep and will be smothered; the one in the center, with crown at the surface, is right; the one at the right is too shallow and will dry out.

cool, moist weather may be depended upon for some time after the plants have been set, such a machine may be used very successfully, and the cost of planting will be comparatively low.

CARE AFTER PLANTING.

Removing flower stems.—Flower stems usually appear on winter or spring set plants soon after they are set. Until they become firmly established after transplanting, the production of fruit is a severe drain on their vitality. Therefore, if the plants do not start well, or if the season is dry, the flower stems should be removed as they appear. Furthermore, when a very large number of plants is needed, the flower stems should be removed, since the runners will increase more rapidly, and better plants will be produced than will be the case

if fruit is allowed to develop. When the plants are thoroughly established in the soil, and an especially large number of runner plants is not needed, the flower stems need not be cut off.

Width of rows.—In general, the width of the matted rows of plants should not be more than 24 inches, and many growers find that rows 12 to 15 inches wide are better than wider ones. It is easier to harvest the berries from plantations where the rows are narrow, and some varieties produce better under such conditions. Where the width is greater than 2 feet, some ripe berries along the center are likely to be overlooked by pickers, and unless the plants are well spaced many berries are likely to be small. Except in the Norfolk (Va.) district, where rows 3, 4, and even 5 feet wide are sometimes made, the matted rows are ordinarily less than 2 feet wide.

Thinning plants.—It will often be necessary to thin the plants in matted rows during the summer and autumn. For this purpose, roller cutters may be attached to the cultivator, so that all runners extending beyond

a certain distance into the alleys will be cut off when the cultivating is done. Surplus runners may also be removed when the field is hoed.

Where the matted row is 2 feet in width, growers sometimes use a method to thin the plants in addition to attaching cutters to the cultivator. A bull-tongue plow with a point about 4 or 5 inches wide may be run down the center of each row, tearing up the center plants. This leaves the row cut into two parts in what might be called a double matted row. Another method sometimes followed is to run across the rows in late summer or autumn with a spike-tooth harrow.

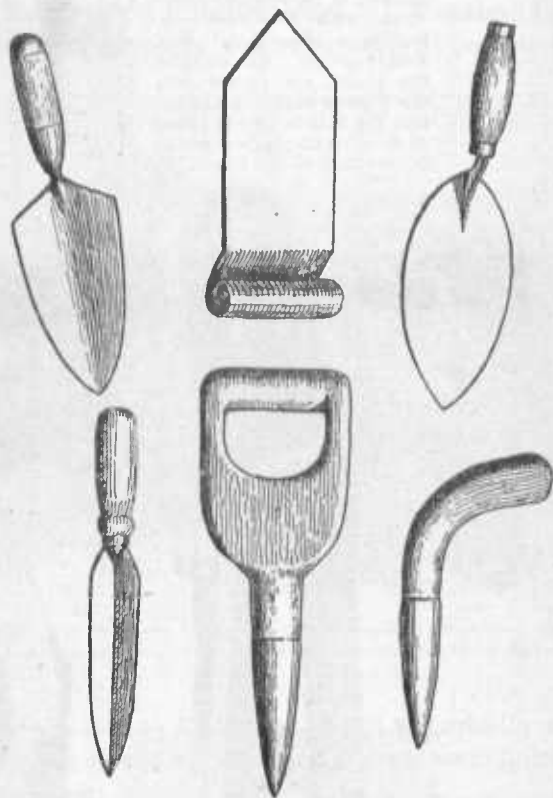


FIG. 13.—Different types of dibbles and trowels commonly used in transplanting strawberries.

The teeth should slant backward, so that only the plants which are not thoroughly rooted will be torn up. This method, however, should

FIG. 14.—A. Setting a strawberry plant with a paddle. This method is adapted to places where the soil is very mellow. The plants are dropped in place, the roots forced into the ground with the steel-tipped paddle, and the soil is then firmed about them with the foot. B. Setting a strawberry plant with a packer. The roots of the plant are forced into the ground with the paddle, and the soil is firmed about them with the packer, which is attached to the handle of



the paddle by clips which allow it to be worked up and down. C. Setting a strawberry plant with punch and tongs. A hole is made with the punch, the roots of the plant placed in it with the tongs, and the soil firmed about them with the foot.

be employed only after careful trial, as there sometimes is danger that too many plants may be loosened.

Spacing plants.—Under the more intensive systems of culture, such as may be used in a home garden and in growing fancy berries, the runner plants may be spaced by hand rather than allowed to root at will. Where this is to be done, as soon as the tips of the first runners begin to enlarge, they should be placed in the rows between the mother plants and covered with soil. The next ones should be placed the length of one runner out from the original row and on each side of it. Additional runners may then be rooted until a wide row has been formed, with the plants at least 6 inches apart. Thereafter, all runners should be cut off as they develop. Sometimes it will be found



FIG. 15.—A common practice in southern Louisiana is to hoe or "scrape" the weeds from the rows of plants into the middles. This is done late in January or in February and pine-straw (needles) mulch is then applied. (Photographed at Independence, La., January 29, 1915.)

cheaper to allow the runner plants to root at will until the middle of August. Then all superfluous plants are dug out and the remainder spaced at equal distances apart.

TILLAGE.

In the Florida districts it is necessary to keep down weeds and maintain the soil in good physical condition until the mulch is put on, which in the central Florida district is usually some time in December and in the Starke district in January or February. One-horse cultivators and hoes are used largely in cultivation before the mulch is applied, but hoes only after the mulching is done.

In the Louisiana district weeds should be kept down and the soil maintained in good tilth by hoeing and cultivating until cold weather sets in. As certain weeds grow vigorously throughout the winter,

much hoeing is necessary during that period. The weeds must be scraped from around the plants, as shown in figure 15. At this time or as soon afterwards as possible, a horse cultivator should be run in the alleys. If weeds continue to grow, the alleys should be hoed or a shallow cultivation given. Great care should be taken to keep the alleys open, so that water may drain off freely and the strawberry roots be disturbed as little as possible. In this district the mulch is usually applied during February. If weeds develop after this time they should be kept down with a hoe.

In sections other than those in Florida and Louisiana, tillage should begin immediately after planting and continue



FIG. 16.—A. Strawberries with onions as a companion crop in the rows. The onion sets are planted in the spring and removed early in the summer, leaving all the space for the strawberries. B. Strawberries with companion crops between the rows. At the left, lettuce, carrots, and beets alter-



nate with the rows of strawberries, while radishes have been harvested at the right, and beans are growing at the extreme right. The extra fertilizer and careful culture given these companion crops are an advantage to the strawberry plants.

each week or ten days until late autumn or into the winter when the mulch is applied. By means of this late tillage it will be possible to keep down the weeds, so that in the spring very little or no hoeing will be necessary.

COMPANION CROPPING.

In order to secure returns from the land during the first summer following spring planting vegetables are frequently grown along the rows or in the alleys between them as companion crops to the strawberries. This practice is followed especially where the matted-row system is used.

Nearly all kinds of vegetables may be raised in this way, and the thorough cultivation given them will be sufficient for the strawberry plants. Most vegetables, however, are susceptible to nematodes, and care should be used to see that infested plants are not set in the strawberry plantation. Vegetables grown from seed should be quite free from this trouble.

Onions may be grown in the strawberry rows, as shown in figure 16, *A*, while such quick-maturing plants as lettuce, radishes, peas, carrots, beets, and the like may be grown between the rows, as shown in figure 16, *B*. The strawberry rows are planted the same distance apart as under ordinary conditions. The vegetables are removed before the strawberry plants begin to spread over the ground to any extent.

When such crops as potatoes, beans, peas, and cabbage are grown with strawberries, special systems of planting the vegetables are often used. Cabbage or cauliflower may be set about 6 inches to one side of the strawberry row. The strawberry plants will be shaded to some extent by the leaves of the cabbage or cauliflower, but when the vegetables are removed during the summer, the strawberries will spread over and occupy the whole space.

When potatoes or beans are used as companion crops, the strawberry rows are usually set somewhat farther apart than in ordinary practice and the companion crop planted in the middle of the alleys between the rows. The strawberry rows should be spaced at least 4 or $4\frac{1}{2}$ feet apart and only a narrow mat of plants allowed to form until after the potatoes are harvested.

THE STRAWBERRY AS AN INTERCROP.

In many sections, strawberries are grown as an intercrop in peach, apple, fig, orange, or other tree-fruit orchards. When the orchard is first planted, strawberries may be set out and grown for several years before the orchard will need all the ground. When this practice is followed, the strawberries should furnish some income from the land or at least pay the expense of caring for the orchard. The intensive cultivation given strawberries is especially good for young orchards, and as strawberries will not bear well unless the moisture conditions are good, they may prove a good indicator of these conditions.

The interplanting of orchards with strawberries, however, should be practiced very cautiously, if at all, and even under the most favorable conditions not more than a row or two should be allowed in the space between two rows of trees. In many instances the competition between the trees and strawberry plants is excessive and seriously detrimental to the trees.

MULCHING.

Commonly a mulch is used in strawberry fields; its principal advantages are that it keeps the berries clean, conserves moisture, and helps to keep down weeds. The materials most commonly used in the South are pine needles, wild hay, and wheat, rye, and oat



FIG. 17.—A. The strawberry field shown in D when partly mulched. This shows how the straw was thrown off the wagon in windrows and then scattered over the rows. B. Strawberries mulched heavily, not only serving to conserve moisture and to

keep the fruit clean, but the extra mulch between the rows may be used to cover the plants to protect the blossoms from late frosts. (Photographed at Starke, Fla., March 29, 1915.) C. Scattering mulch by hand over the strawberry field. This method involves more labor than that shown in D. (Photographed at Starke, Fla., February 6, 1915.) D. Mulching the strawberry field with wheat straw thrown from a wagon. This method is more rapid and less laborious than handwork. E. A handcart for scattering mulching material over a field of strawberries.

straw; all are satisfactory. When pine needles are used they are raked during the winter and are usually stacked along one side or on both sides of the field.

In nearly all parts of the South the mulch is applied just before the blossoms open. Where the hill system is followed the mulch is

distributed over the fields by hand with a handcart, as shown in figure 17, *E*, or on a rack, as shown in figure 17, *D*. Where the matted-row system of culture is used it is generally placed in windrows and spread by hand, as shown in figure 17, *A* and *C*.

Sufficient mulch should be applied so that after settling it will be 1 to 3 inches deep. This will require several large 2-horse hayracks of material to the acre.

In the central Florida district, the mulch is used not so much for keeping the berries clean as to protect the flowers and fruit from frosts. In this district, the mulch is put in the alleys and when there is danger of frosts it is spread over the plants. A small quantity of pine needles, wild hay, or straw over the rows will afford protection from ordinary frosts, though the temperature over a mulched field is lower, other things being the same, than over an unmulched field. In the Starke district of Florida, strawberry fields are mulched to keep the berries clean as well as to protect the plants from frost. (Fig. 17, *B*.)

At the beginning of the strawberry season, where a mulch has been used, some of the berries are likely to be lost from cricket injury. The crickets hide in the mulch by day and at night eat the ripening fruit. Unless partly eaten berries are picked, they rot and spread disease to neighboring berries. The damage done by crickets is not often serious, and it may be largely prevented by scattering along the rows poisoned bran mash made by mixing 1 pound of white arsenic and 12 pounds of bran in water.

GREEN-MANURE CROPS.

Green-manure crops are those grown to enrich the soil and particularly to increase the humus and moisture-holding capacity. In the South, good crops of strawberries are very largely dependent on an ample humus supply. When the supply is adequate, the plants grow better, and drought does not affect the crops as quickly as when it is deficient. Oats, rye, the Iron and Brabham varieties of cowpeas, velvet beans, and crab-grass are used extensively as green-manure crops. Winter oats (or winter rye) and cowpeas if turned under, as in the North Carolina rotation previously mentioned, should furnish sufficient humus unless the soil is seriously deficient when the plants are set.

In some sections the strawberries occupy the ground during the winter and early spring only, being plowed under in the spring after the crop is harvested. A green-manure crop or corn with cowpeas between the rows may then be planted. The green-manure crop is plowed under or the corn harvested and the cowpeas plowed under before the field is reset to strawberries in the autumn. The cowpeas,

of course, should be of the Iron or Brabham variety because of their resistance to nematodes. Where a field is to be renewed without resetting the plants, green-manure crops may be sown between the rows during certain periods and later worked into the soil.

FERTILIZERS AND LIME.

The use of fertilizers and stable manure on strawberry fields is governed largely by the same principles that apply to their use on other crops. As soils vary greatly in their composition, the use of fertilizers is chiefly a local question, to be determined by each man for his conditions. This can be done by applying the different plant foods (nitrogen, phosphoric acid, and potash) separately, in different combinations, and in varying quantities to small plats and keeping a record of the yields. In like manner different quantities of stable manure should also be applied to small plats to test its value.

If certain facts are kept in mind they will help the grower to determine how much to use. A good crop of strawberries will remove considerable plant food. Excepting coarse sand, however, most soils are so well supplied with plant food that large crops of strawberries can be produced without applying fertilizers, provided the physical condition of the soil is good. If, therefore, the soil is kept in a satisfactory condition by the addition of humus, by adequate drainage, and by frequent tillage, and if the moisture supply is ample, many strawberry fields will need no fertilizer or stable manure. In many localities, however, the use of fertilizers has been found profitable, and in such areas growers should determine the kind and quantity necessary for their conditions in the manner suggested above.

Under the hill system of culture, the fertilizer, when applied, is usually scattered along the rows, and the soil thrown on top before the plants are set. Some growers, however, use only part of the fertilizer at that time, applying the remainder after the plants have become well established. In the district about Houston, Tex., ordinarily no fertilizer is used under any system of training. In other districts where the matted row is used, sometimes the fertilizer is applied just before the plants are set, sometimes after growth has started, and sometimes in the autumn.

Lime ordinarily should not be used, as it has been found to be injurious to the roots of strawberries. Sometimes, when the soil is in poor physical condition, it may pay to use it, but in such cases it is better to apply the lime at a time when cowpeas are to be raised and not just before the strawberries are set or during the period when the plants occupy the land.

IRRIGATING.

Droughts occur so often during the long growing season and the loss from drought is so often serious that frequently it will pay to make provision for irrigating strawberries. Many growers have done this. Either the overhead sprinkling or the surface system may be used, according to the local conditions. At present, the sprinkling system is most often used in Florida, while surface irrigation is common in Louisiana and Texas. The sprinkling system is expensive to install, costing \$100 to \$250, or even more, per acre, but when once installed it is easy to operate. This system is especially valuable in Florida for propagating plants.

Water for surface irrigation is commonly secured in the Hammond district of Louisiana from arte-



FIG. 18.—A. Setting strawberries under irrigation. Water is run down every other middle, leaving the alternate ones dry for the convenience of those who are setting the plants. Note that double rows are set on the ridges. (Photographed at Hammond, La., November 21, 1914.) B. Strawberries being irrigated during the picking season. Water

is run down each alternate middle, leaving dry spaces for the pickers. (Photographed at Ponchatoula, La., April 13, 1915.)

sian wells and in the Houston district in Texas by pumping from bayons, streams, and lakes. When an artesian well has been bored a continuous water supply is available, and the only cost is in distributing it in the field. It is used in summer, when drought occurs, in order to save the propagating beds; at planting time it is frequently applied to moisten the soil for setting; and again during the fruiting season it is used in order to counteract the effects of drought.

When the water is being applied, the alleys should be free from obstacles. The rows should be not more than 500 feet long, and preferably not over 300 feet, so that the water can run down the alleys without too great loss. During the planting and picking seasons water should be run down every other alley, as shown in figure 18, so that the workers may walk in the unirrigated furrows. At the next irrigation the alleys previously omitted should receive the water, thus alternating at each application. The water should not be allowed to touch the leaves, as under a bright sun foliage that has been wet will "scald" and die. Wherever possible, about two days after each irrigation, when the soil is in suitable condition for working, the irrigated alleys should be cultivated.

In the Houston district of Texas, the expense of installing and keeping up pumping stations is considerable. Furthermore, there is no season when heavy rains may not be expected, and if an irrigation is followed by heavy rains, the plants may suffer severely. For these reasons, irrigation is used somewhat less than formerly; but as severe droughts are common many have found some irrigation necessary, and it is used more or less in the summer, at planting time, and at the harvest season, the last especially as an aid in keeping up the size of the fruit as harvesting progresses.

RENEWING THE PLANTATION.

Where the hill system is used, the plantation is rarely renewed, but is plowed up at the end of the first fruiting season. The cost of renewing under the matted-row system is usually less than that of setting and caring for a new plantation. Therefore, where the matted-row system is used, the fields are kept from two to five or six years, or as long as they produce profitable crops. The length of time a plantation may be kept profitably depends upon the quantity of humus in the soil and upon the prevalence of diseases and weeds. If green-manure crops were turned under before the plantation was set, so that the soil is in good condition, two or more crops may be harvested before it should be plowed up and a new one set, but if nematodes or diseases do much injury, the field may become unprofitable even though the humus supply is ample. Furthermore, if a field becomes very weedy, it may be more profitable to use the land for some other crop than to continue it in strawberries. Local conditions, therefore, largely govern the length of time a field may be profitable.

Mowing and burning.—In renewing a plantation the field should first be cut over with a mowing machine. Where the growing season is long, as in the South, the mowing may be delayed several weeks after the picking season, unless it is desirable to burn over the field

as a means of destroying weevils. In that case the mowing and burning should be done immediately after the crop is harvested.

If injuries from diseases and insects are not serious, the foliage and mulch should generally be turned under. This will increase the humus content of the soil, and put it in better condition than if burning is practiced. When the mulch is very heavy, however, it may be necessary to remove a part of it before plowing. If it is not too much decayed, the mulch is sometimes raked up and stacked for use the following year, and only the strawberry foliage is plowed under.

Where insects and leaf-spot diseases are prevalent, growers prefer to burn the foliage and mulch in the field. It is then easier to thin the plants and narrow the rows than if the mulch and leaves are left. As soon as the foliage has dried, the mulch should be raked on top of the rows, and when a good breeze is blowing in the direction the rows run, a fire should be started to the windward side. When burned in this way, the fire will pass quickly, and the roots and crowns of the plants are not likely to be injured. The foliage should not be burned, however, when the ground is very dry or when the mulch and leaves are damp.

Thinning the plants.—When renewing a plantation it is desirable to reduce the number of plants in the matted row so that new runner plants will have a better chance to develop. The amount of thinning necessary will depend upon the variety, and to some extent upon the season and the soil. If the variety raised is one that will make a large number of runner plants later in the year, the row should be reduced to 6 or 8 inches in width, and the plants in this row thinned so that they are at least 10 inches apart. If the variety does not make many plants in late summer and autumn, the row should be left 12 to 15 inches wide and the plants about 10 inches apart.

To reduce the width of the row, either one side or part of both sides of each row should be plowed. Usually it is best to plow one entire side of the row and also the old plants in the middle. This will leave only the younger plants on one side. The remaining plants are then thinned by running a spike-tooth harrow or cultivator across the rows once or twice and then once down the row. The weaker plants are torn up by this process, and the ridges made by plowing up one side of the row are leveled. A hoe may be used in further thinning the plants if they are still too thick. The crowns of the plants that are left are usually covered with an inch or two of soil. Within two or three weeks under favorable conditions, the plants will have sent out new foliage, and the field will have the appearance of a young plantation.

In many sections the rows are moved by plowing up one side of each row one year and having the remaining plants set runners in the alleys. The other half of the old row is plowed up the following year when the plantation is renewed, so that by the third year the rows run where the alleys were at first.

If the narrow matted-row system has been used, it may be necessary to reduce the width of the rows very little, if at all. A shovel cultivator may then be used to plow across the rows, leaving the plants in small clumps about 24 inches apart. Later in the summer the runners will fill the spaces thus plowed and make continuous matted rows by winter.

HARVESTING AND SHIPPING.¹

After berries of the best grade are grown they can not reach the market in the best condition unless they are handled with great care. The field should be picked over at least every other day, and at the height of the season it will often be necessary to pick the fruit daily. No ripe berries should be left, since at the next picking they will be too soft to ship. One soft berry in a basket may spoil the entire contents, and one spoiled basket of berries may spoil the looks of the crate by the time it reaches the market. The habit of growth of the foliage and differences in growth of different varieties make it more difficult to pick clean in some sections than in others. The way in which dense foliage may hide the berries is shown in figure 19, *B*, in contrast to the more open habit of growth shown in figure 19, *A*. In picking, the stem should be pinched off, leaving about half an inch attached to the berry. Each berry should be placed carefully (not thrown or dropped) in the basket. Baskets of berries should never be left in the sun, but should be taken to the packing shed or placed in the shade as soon as possible after the fruit is picked.

Pickers and picking.—Pickers are paid from 1 to 2 cents a quart for gathering the berries. The price varies with the section, with the grade of work done, and with the plan of management. Thus, in one section pickers are paid 6 cents a gallon, and if they stay until the end of the season, they are given another cent for each gallon picked during the season. This system serves to hold the pickers through the latter part of the season, when the berries are smaller and less plentiful. In another section some growers pay the best pickers one-half cent a quart more than untrained and poor pickers. They consider that the extra pay encourages careful work and that the berries are worth more when handled by the best pickers.

¹ See also Farmers' Bulletin 979, entitled "Preparation of Strawberries for Market," which may be obtained without charge on request to the Secretary of Agriculture.

The number of pickers to the acre varies greatly. Where the yields are small two pickers to the acre are sufficient. On the other hand, eight or ten are sometimes needed in the height of the season on the best fields. On a field yielding 100 crates (24-quart) to the acre, four pickers working every day should take care of the crop.

In a field that is given good attention there should be very few berries that are not of the best market grade. From some fields almost perfect berries have been secured, and no sorting after picking has been necessary. To secure crops of such fruit, however, the plants should be properly spaced in the row, the field must be free from weeds and



FIG. 19.—A. Strawberry plants which were set in September, 1915, showing the open habit of growth as compared with those shown in B and C. These berries are much easier to pick than where they are concealed, as in B. (Photographed at Chadbourn, N. C., May 3, 1916.) B. A Klondike strawberry plant, showing the heavy foliage which hides the berries. This makes picking difficult. C. The same strawberry plant shown in B, but with some leaves removed, showing the berries.

grass, and the mulch and the humus in the soil must be sufficient to maintain an adequate supply of moisture while the berries are growing and ripening.

Carriers and crates.—Carriers holding six 1-quart baskets are used in picking in most districts in the South Atlantic and Gulf States. Two types of carriers in common use are shown in figure 20, B.

The crate shown in figure 20, B, is in common use in Alabama, Mississippi, and Texas. It holds 24 1-quart baskets and is not usually returned to the grower when emptied. A somewhat similar type of crate holding either 24 pints or 24 quarts is used in Louisiana, and

to a slight extent in Texas. The 32-quart crate shown in figure 20, *C*, is commonly used along the Atlantic coast, although in the Norfolk district in Virginia a 60-quart crate is also used. The pony refrigerator shown in figure 20, *A*, is used largely in the central Florida district. This is made in two sizes, holds 64 or 80 quarts of berries, and is provided either at the top or in the center with



FIG. 20.—*A*. A pony refrigerator which is used to ship strawberries from Florida to northern markets. Two sizes are used, 60-quart and 80-quart. The ice pan which fits in the top is shown at the right. The tight-fitting cover is at the left. *B*. The strawberry shipping crates shown hold 24 quart baskets each. They are cheaply constructed and sometimes are called gift crates, because they are not returned to the shippers. The covers are nailed on. Two types of carriers used by pickers are shown in front. *C*. A 32-quart crate of better construction than those shown in *B*. The cover is hinged, with a catch fastener in front. These crates are usually returned to the shippers.

a metal tray which is filled with ice. A good type of packing house, typical of those much used in the South, is shown in figure 21.

VARIETIES.

In the whole area to which this bulletin applies only two varieties, the Klondike and the Missionary, are grown extensively. The Klondike is the sort preferred in all districts except central Florida. The Missionary is liked best in central Florida, where it has almost entirely replaced other sorts. It is also grown extensively at Rose Hill and Mount Olive, N. C., and at Norfolk, Va., but although very productive it does not ship as well as the Klondike, and seems to be losing favor in those districts.

Other sorts which are raised to a slight extent are the Neuman at Dickinson, Tex., the Excelsior at Pasadena, Tex., the Nick Olmer and Brandywine in the central Florida district, the Thompson (*Lady Thompson*) in the home gardens of North Carolina and South



FIG. 21.—A strawberry packing house at Tyler, Tex. The pickers place their berries on the broad, protected shelf in front, and the baskets are packed in the crates inside the house. The crates of berries are loaded into the wagon from the door at the end.

Carolina, and the Excelsior and Jamestown about Norfolk, Va. None of these sorts, however, is as desirable generally as the Klondike and the Missionary.

New sorts should be tested carefully before large areas are planted to them. If they are to succeed, they must be able to endure the heat and humidity of the southern summer, and must be somewhat resistant to diseases. The varieties now raised in these regions originated in the South, and it is not likely that northern sorts will prove adapted to southern conditions. In testing new sorts, therefore, those originating in the South should be regarded as more likely to prove of value than those originating in the North.

INSECTS AND DISEASES.

Crickets injury and the methods of combating it as well as the control of the white grub have already been discussed. Other in-

sects likely to cause serious injury are the red spider, the weevil, and the root louse. Methods of controlling nematodes and the "crimp" have been recommended on previous pages.

No extended discussion of insects and diseases can be given in the present connection. The grower should familiarize himself, so far as possible, with those that are likely to occur in his locality and thus be able to recognize and combat them as soon as discovered. Information relating to strawberry insects and diseases may be found in many bulletins of the State agricultural experiment stations and in publications issued by the United States Department of Agriculture. Growers should be in close touch with the stations in their own States, and upon the discovery of any insect or disease with which they are not familiar, they should send specimens to their stations or to the United States Department of Agriculture for examination. Early recognition of an insect or disease newly discovered in a community may make possible the application of control measures which will prevent a serious outbreak that otherwise would be a menace to the entire community.

USES OF THE STRAWBERRY.

Many million dollars' worth of strawberry products are manufactured each year. Among the more important of these are preserves, jams, essences for flavoring candies and for use as flavoring extracts, sirup for soda fountains, and crushed fruit for flavoring ice cream and sauces. Large quantities of strawberries are also canned. The varieties commonly used for these purposes are deep red to the center, acid, with a strong strawberry flavor, and firm fleshed, so they will not break to pieces in cooking. Among the best varieties for such purposes are the Klondike, Wilson, and Clark. In sections where these sorts are not well adapted, the Parsons, Superior, Marshall, Warfield, Dunlap, Gandy, Joe, Missionary, and others are grown.

Many factories for utilizing the strawberry have been put up in the large producing areas. Other factories, to which the fruit is shipped, are located in the cities. The managers of these factories have found that the strawberry is in the best condition for use if picked while very firm, even before it is fully ripe, and made up the same day. The factories located in the producing areas, therefore, have an opportunity to make the finest product. In utilizing strawberries in the home or for the market, the experience of these concerns in selecting certain varieties and in using firm berries the same day they are picked should be followed. The directions for making strawberry products given on the following pages are based largely on the experience of commercial concerns.

CANNING.

Sort out defective berries; wash and hull; pack the jars level full with sound, firm berries not fully ripe; fill the jars with sirup of 30° Balling density made by boiling 3 pounds 9 ounces (18 cups) of sugar in 1 gallon (16 cups) of water until the sugar is dissolved, and then process¹ pint jars 10 minutes and quart jars 12 minutes. To make an especially fine product in the home, heat the smaller and softer berries and strain the juice from them, using this juice with sugar to make a sirup. Pour this sirup boiling hot over the berries in the jars and process as directed above. Instead of processing 12 minutes in the usual way, the cans may be placed in a kettle of boiling water and the kettle covered tightly. It is at once removed from the stove and allowed to cool before the jars are removed from the water. Commercial canners wash the berries after instead of before hulling, and use sirups varying from 30° to 60° density; for pie stock, they often can strawberries without the use of sugar.

PRESERVING.

Recipe No. 1.—Sort out defective berries; wash and hull. Make a sirup by adding 35 ounces (5 cups) of sugar to one cup of water and bring to the boiling point. Add 2½ pounds (almost 2 quarts) of berries to this hot sirup; boil until a candy or chemical thermometer registers 222° F., or until the sirup is thick. Pack the jars level full of berries and fill with the sirup. Process pint jars at simmering (188° F.) for 30 minutes.

Recipe No. 2.—Sort out defective berries; wash and hull. Add three-fourths pound of sugar to each pound of berries; let them stand over night in a warm room; drain off the juice and reduce by boiling until it thickens into a sirup; pack the fruit in jars and pour the hot sirup over it; let it stand for 24 hours; heat slowly to the boiling point in a water bath; remove from the water and seal.

Recipe No. 3.—Sort out defective berries; wash and hull. Heat the smaller and softer berries and strain the juice from them. To 1½ pounds (almost 3½ cups) of sugar add one cup of the berry juice; bring to the boiling point; then cool. When cool add the berries, a few at a time; heat slowly to the boiling point and cook until the berries are bright and transparent (106° C. or 223° F.); cool and pack in cold sterilized jars. Process pint jars at simmering for 30 minutes.

¹ To process, place the jars in a water bath on a rack which allows circulation of water beneath them. Have the water about the same temperature as the contents of the jars. The water should be about an inch over the tops of the jars. Have the covers on the jars but not tightened. Note the time when the water begins to boil and keep boiling steadily for the time required; then remove the jars promptly and tighten the covers.

SUN PRESERVING.

Recipe No. 1.—Select sound, ripe berries; wash and hull. Prepare a sirup by adding three-fourths pound ($1\frac{1}{4}$ cups) of sugar to each pound of berries and let them stand for several hours in a warm room to extract the juice. Then drain off the juice and heat it. When it boils, add the berries and cook for five minutes. Remove from the fire, spread in shallow platters, cover with glass, and put in the sun while hot. Leave in the sun until the sirup thickens; then put in sterilized jars and cover with hot paraffin.

Recipe No. 2.—Select sound, ripe berries; wash and hull. Use three-fourths pound ($1\frac{1}{4}$ cups) of sugar to 1 pound of berries; put the berries in a kettle in a warm place until the sugar is dissolved. Bring to a boil, remove from the fire, spread on shallow platters, cover with glass, and put in the sun while hot; leave in the sun until the sirup thickens; then put in sterilized jars and cover with hot paraffin.

STRAWBERRY JAM.

Sort out defective berries; wash and hull. Mash thoroughly and add three-fourths pound ($1\frac{1}{4}$ cups) of sugar to each pound of berries; cook slowly for 20 minutes, or until the jam is of the desired thickness. Pack in sterilized jars; cover with paraffin or seal after processing for five minutes in a hot-water bath.

COMBINATIONS WITH OTHER FRUITS.

In making preserves and jams, strawberries are often combined with other fruits. Such products are preferred by many to those made of strawberries alone. Among the combinations considered most desirable, are strawberry-raspberry, strawberry-pineapple, and strawberry-rhubarb preserves and strawberry-currant and strawberry-gooseberry jams. Although these fruits may be combined in any proportion, the following procedure will be found desirable.

Strawberry-raspberry preserves.—Crush, heat, and extract the juice from raspberries; use 1 cup of raspberry juice and $2\frac{1}{4}$ cups (almost 1 pound) of sugar for each quart of sound hulled strawberries. Proceed as for strawberry preserves.

Strawberry-pineapple preserves.—Use 1 pound of grated or chopped pineapple, 2 pounds of strawberries, and $2\frac{1}{4}$ pounds (5 cups) of sugar. Bring the pineapple and sugar slowly to the boiling point and boil for about 10 minutes; then add the strawberries and cook slowly until thick; put in sterilized jars and seal.

Strawberry-rhubarb preserves.—Use 1 quart of chopped rhubarb and $1\frac{1}{4}$ pounds (4 cups) of sugar to one-third quart of strawberries. Proceed as for strawberry preserves.

Strawberry-currant jam.—Use three-fourths pound ($1\frac{1}{2}$ cups) of sugar and 1 pint of currant juice to 4 pounds (about $2\frac{3}{4}$ quarts) of strawberries. Proceed as for strawberry jam.

Strawberry-gooseberry jam.—Use 2 cups of gooseberry pulp and $4\frac{1}{2}$ cups of sugar to 2 pounds of strawberries. Proceed as for strawberry jam.

Strawberry-kumquat jelly.—Wash the strawberries through three changes of water; pour into a colander, cap, place in a preserving kettle, and boil 10 minutes, stirring constantly; pour into a jelly bag and allow to drain. Next, wash the kumquats thoroughly, sprinkle with soda, using about 1 tablespoonful to each pound of fruit, pour over sufficient boiling water to cover the fruit, and let stand 10 minutes. Then remove the fruits, rinse in three changes of water, cut the fruits in two lengthwise, place in kettle, add 1 quart of water for each pound of fruit, and boil for half an hour. Pour into a cheesecloth bag and press until no more juice is obtained. Strain the juice through a clean jelly bag. Use strawberry juice at the rate of half a pint to each pint of kumquat juice. Bring to a boil and add sugar at the rate of 1 pound to each $1\frac{1}{2}$ pints of the mixed juice. Continue boiling until the jelling point is reached, which is indicated by its flaking or sheeting from the spoon. Put into glasses and treat as other jellies are treated.

Strawberry juice.—Strawberry juice is a refreshing beverage, especially when combined with other fruit juices. One of the best combinations is made by the addition of the juice of one lemon to each pint of strawberry juice. This combination must be sweetened and diluted according to taste. The strawberry juice is prepared by heating the berries almost, but not quite, to the boiling point and at once straining out the juice. Strawberry juice will not keep its flavor or color for long periods unless stored at a low temperature.

COLD STORAGE.

First method.—When the preservation of the fresh-fruit flavor is desirable, the following method may be used for packing small quantities of strawberries for use when they are not in season: Select sound, ripe berries; wash and hull. Use a tin of convenient size, to which a tight cover can be fitted. To each 10 pounds of fruit use one cup of sugar; fill the cans with sugar and berries; put on the tops and cover their edges with the adhesive tape used in sealing packages; put in freezing cold storage and keep frozen until wanted. This product can be used for shortcakes, etc., by restaurants and hotels, for crushed fruit at soda fountains, and by ice-cream manufacturers.

Second method.—The large manufacturers of the crushed fruits and sirups used by the soda-fountain and ice-cream trade prepare their product as it is needed at any time during the year from un-

cooked berries which are kept in barrels in cold storage preserved in the following manner: The berries are hulled and sorted and then washed. The washing is done by running the berries on a belt through a tank of water; then over another belt, where they are slowly turned and sprayed with water. The berries drop into pans and are weighed. To each pound of berries, sugar is added, varying from one-half to 1 pound. Usually, however, the proportion is one-half pound of sugar to 1 pound of fruit. The proper proportions to use will depend upon the variety, the ripeness of the fruit, the moisture conditions, and the way in which the product is to be used. Heavy water-tight barrels holding about 375 pounds of the mixture of berries and sugar are used. Before use they are carefully examined and coated on the inside with paraffin, which is applied while hot with a paintbrush. New barrels may need special treatment to prevent the berries from absorbing a woody taste. The sugar and berries are put in alternate layers and mixed by machine or by hand. As soon as the barrels are headed, they are shipped in a refrigerator car to a cold-storage warehouse, where they are held at a temperature of 30° F. or lower. Several thousand barrels of strawberries are put up in this manner every year.

After washing, the berries are sometimes dropped into a mixing tank, where the sugar and berries are thoroughly mixed by constant stirring. This tank is surrounded with ice water, in order to cool the fruit before it goes into the barrels.

If equal weights of sugar and berries are used, the barrels of fruit may be stored at a temperature of 34° to 36° F.; but if the fruit is to be held for long periods, the flavor is best preserved at a lower temperature.

